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(54) Title: **BY HAND TEARABLE COMPOSITE MATERIAL**

(57) Abstract: The present invention relates to a by hand tearable composite material, in particular for use as a substrate for an adhesive tape such as, for example, a pressure-sensitive adhesive tape. According to one main embodiment, the composite material comprises a reinforcement layer in the form of a weft inserted knitted fabric, and at least one extruded layer of thermoplastic material on one surface of the reinforcement layer. According to another main embodiment, the composite material comprises a reinforcement layer in the form of a laid fabric consisting of a warp and a weft, and at least one extruded layer of thermoplastic material on one surface of the reinforcement layer. Production costs are thus significantly lowered without sacrificing other properties of the composite material.

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By Hand Tearable Composite Material

5 The present invention relates to a by hand tearable composite material, in particular for use as a substrate for an adhesive tape such as, for example, a pressure-sensitive adhesive tape.

0 US patent no. 4 304 813 and European patent no. 0 466 342, the entire contents of which documents are incorporated herein by reference, disclose pressure-sensitive adhesive tapes having a substrate comprising a plastic film as a base or backing layer, and a fabric layer adjacent the film. A coating of pressure-sensitive adhesive is applied over an outer surface of the
5 fabric layer and passes through the fabric to the film. The adhesive bonds the film and fabric layers together as a laminate.

0 By employing a fabric having a relatively open construction as described in the above-referenced documents, it is possible to produce a tape which is light-weight and has good distribution of the adhesive. The tapes disclosed in the above documents are also able to be readily torn by hand. Those tapes, however, have the disadvantage of relatively poor dimensional stability
5 and are therefore easily distorted. Furthermore they are relatively expensive to manufacture.

0 It is accordingly an aim of the invention to provide a composite material which is in particular suited for the production of an improved and less costly adhesive tape which may exhibit the advantages of the prior art tapes described above without the same degree of susceptibility to distortion.

5 To this end, the present invention provides in its broadest form a by hand tearable composite material which is in particular suited as a substrate for an adhesive tape and which comprises a reinforcement layer in the form of a weft inserted

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knitted fabric, and at least one extruded layer of thermo-
plastic material on one surface of the reinforcement layer.
According to an alternative main embodiment of the invention
the composite material comprises a reinforcement layer in the
5 form of a laid fabric consisting of a warp and a weft, and at
least one extruded layer of thermoplastic material on one
surface of the reinforcement layer. In this latter embodiment
of the invention the reinforcement layer contains at least one
non-interconnected direction of ends. Warp and/or weft ends may
0 be directly laid into the "soft" material of the extruded layer
during or immediately after the extrusion process.

By extruding the at least one layer of thermoplastic material
to the reinforcement layer, the latter is at least partially
5 thermally bonded to the thermoplastic material without use of
an adhesive. The heat bonding is effected between the opposed
facing surfaces of the thermoplastic material and reinforcement
layers. That is, the thermal bonding occurs at the interface
between the layers. The nature of the reinforcement layer
0 permits good tearability by hand.

As is readily apparent from the above description of the two
main embodiments of the invention, no film material is used in
manufacturing the composite material. Instead, the
5 thermoplastic material is extruded onto the reinforcement
layer. Extruding the thermoplastic material onto the
reinforcement layer permits to use plastic pellets as starting
material instead of having to use a plastic film which is much
more costly than pellets. Production costs of the composite
0 material are thus significantly lowered. Further savings may be
obtained by way of the present invention if an adhesive is to
be applied to the composite material. With known fabric-film
constructions, a substantial part of the adhesive applied to
the fabric side of the composite material just fills the voids
5 in the fabric without actually contributing to the desired
adhesive properties of the final product. According to the
present invention, however, due to the thermoplastic material

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being extruded onto the fabric the thermoplastic material, while still being "soft", at least partly fills the voids in the fabric thus on the one hand achieving good bonding between the fabric reinforcement layer and the layer of thermoplastic material and on the other hand creating a smoother, flatter surface on the other side of the fabric layer, i.e. the side of the fabric which is not coated with thermoplastic material. Therefore less adhesive needs to be applied to obtain the desired adhesive properties.

In preferred embodiments of the present invention, the composite material comprises at least one extruded layer of preferably thermoplastic material on the other surface of the reinforcement layer. Dimensional stability of the composite material is thus enhanced while tearability is not significantly imparted.

In one embodiment of the present invention the at least one extruded layer of thermoplastic material on the one surface of the reinforcement layer consists of thermoplastic rubber. According to a modification of this embodiment, also the at least one extruded layer of thermoplastic material on the other surface of the reinforcement layer consists of thermoplastic rubber. According to another modification of this embodiment, the at least one extruded layer on the other surface of the reinforcement layer consists of thermoset rubber.

In embodiments of the present invention, where the thermoplastic material is thermoplastic rubber, the thermoplastic rubber advantageously contains a polyolefine, preferably polypropylene or polyethylene.

As has been pointed out above, bonding between the reinforcement layer and the extruded layer on the one surface or on both surfaces of the reinforcement layer is effected by way of the extrusion process, i.e. while the extruded material is still in a "soft" state. In a preferred form of the

invention the reinforcement layer is thermally bonded to the thermoplastic layer at a plurality of discrete locations over the interface between the fabric and the thermoplastic material. Desirably, the bond locations between the
5 reinforcement layer and the at least one extruded layer on one or both surfaces of the reinforcement layer are relatively evenly distributed, preferably substantially evenly distributed over the extruded material-reinforcement layer interface area. This assures good dimensional stability as well as good
0 tearability of the composite material of the present invention all over the composite material. Alternatively, the thermal bonding may be effected over substantially the entire area of contact between the reinforcement layer and the thermoplastic layer. While it is possible for the extruded material to cover
5 only part of the surface area of the reinforcement layer, it is preferred that the extruded material covers substantially the entire surface area of the reinforcement layer.

In order to obtain good tearability characteristics of the
0 composite material in normal use, the pitch between weft ends is preferably at least 2 mm, i.e. the spacing between adjacent weft ends is at least 2 mm measured axis to axis.

To obtain good dimensional stability and load bearing
5 characteristics, the pitch between warp ends of the composite material of the present invention is preferably less than 2.5 mm, more preferably less than 1.4 mm, i.e. there should be at least seven warp ends per cm.

0 If the composite material of the present invention is intended to be used in the making of adhesive tapes, an adhesive is provided at an outer surface of said composite material. The independent bonding of the layer of extruded material and the reinforcement layer in the composite material may be achieved
5 by physical bonding, chemical bonding or a combination of both physical and chemical bonding. Desirably, however, the adhesive provided at the outer surface of the composite material may

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further enhance the bonding between the composite material layers.

In one form of the invention the adhesive properties are
5 obtained from a coating of adhesive applied to an outer surface of the composite material. The outer surface of the composite material may be a surface of the reinforcement layer. On the other hand, however, the composite material may include a layer of extruded material on each side of the reinforcement layer.
0 For example, the composite material may include a further layer of extruded material adjacent to and in opposed face-to-face relation with the other side of the reinforcement layer; i.e. such that the reinforcement layer is sandwiched between two thermoplastic layers. The adhesive is then applied to an outer
5 surface of one of the thermoplastic layers.

The layer(s) of extruded material and the reinforcement layer are typically in the form of substantially planar strips, each strip having two main (upper and lower) surfaces. The extruded
0 material and reinforcement layer strips typically have the same length and width dimensions (the thickness of the layers will typically differ, but may also be equal) and are superposed adjacent one another such that they are essentially coextensive.

5 In a preferred form of the invention the reinforcement layer is manufactured from yarn that includes at least some thermoplastic synthetic. Accordingly, the reinforcement layer may be manufactured purely from a thermoplastic synthetic yarn or, alternatively, may be manufactured from a combination or
0 blend of different yarns which include a thermoplastic synthetic. The yarn in the reinforcement layer may also include a finish or component that promotes adhesion to the layer of extruded material; an example being a co-extruded yarn with one
5 fibre type having low melt properties. For example, the yarn of the reinforcement layer preferably includes at least a proportion of PVC, polyurethane, polyester, polyethylene,

polypropylene and/or polyamide. Upon heating, the thermoplastic part of the yarn softens and fuses to the layer of extruded material. The yarn may also, however, include non-thermoplastic fibres or filaments such as rayon, viscose, or natural fibres
5 such as cotton, flax, wool and/or silk.

The reinforcement layer itself is manufactured using either knitting or laying. When knitting is used, the fabric is manufactured with a "warp knitted-weft insertion" construction.
10 Desirably, the fabric has a relatively open construction to facilitate distribution of the adhesive, in the case that the adhesive is applied to the surface of the reinforcement layer facing away from the layer of extruded material. The fabric may optionally be manufactured such that it includes tape yarns in
5 the weft and/or warp.

In a preferred form of the invention the thermoplastic layer is manufactured from a thermoplastic polymer. Accordingly, upon heating, the thermoplastic layer softens and fuses to the yarns
10 of the reinforcement layer. In a very preferred form of the invention, both the yarn of the reinforcement layer and the thermoplastic layer include a thermoplastic polymer (most preferably, the same polymer) such that heating causes a softening of both the fabric yarns and the thermoplastic layer
5 enabling a fusion welding between the layers.

After a thermoplastic layer and a reinforcement layer are thermally bonded to one another to form a composite material, a coating of adhesive may be applied to the outer surface of the
10 reinforcement layer, i.e. that surface which faces away from the thermoplastic layer. In one form of this invention the adhesive is pressed into and through the fabric, for example by calendering as in US 4 304 813 and EP 0 466 342, to create a further bond or adhesion between the reinforcement layer and
5 the thermoplastic layer. The adhesive is preferably a rubber gum pressure-sensitive adhesive as typically known in the art.

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Accordingly, the present invention is able to provide a pressure-sensitive adhesive tape in which the reinforcement layer is bonded to the thermoplastic layer both by thermal bonding as well as by adhesive bonding, thus rendering the
5 yarns of the reinforcement layer substantially more dimensionally stable within the tape and significantly reducing the tape's susceptibility to distortion. There is therefore less tendency for the reinforcement layer yarns in the tape to shift (particularly with more open fabrics) as a result of the
0 superior bonding between the reinforcement layer and the thermoplastic layer.

According to another broad aspect the present invention provides a method of manufacturing an adhesive composite
5 material, comprising the steps of:

- extruding a layer of thermoplastic material to at least a portion of a surface area of a reinforcement layer of weft inserted knitted fabric or a laid fabric consisting of a warp and a weft, and
- 0 - applying an adhesive to an outer surface of the composite material.

The thermoplastic coating may be applied to just one or to both surfaces of the reinforcement layer, and preferably covers the
5 entire surface area. Furthermore, the thermoplastic material is preferably a thermoplastic polymer, and the fabric also preferably includes at least a proportion of thermoplastic fibres, filaments or yarn, as also describe above.

0 In the event that the composite material only includes one thermoplastic layer and one reinforcement layer, then the adhesive is preferably applied to an outer surface of the reinforcement layer, namely the surface facing away from the thermoplastic layer. However, the composite material may
5 include a further layer of extruded material bonded to the other side of the reinforcement layer, in which case the

adhesive is applied over an outer surface of one of the thermoplastic, or in general, extruded layers.

5 In a preferred form of the invention the layer of extruded material and the reinforcement layer are in the form of substantially coextensive sheets, which may be thermally bonded together by extrusion as described above or in a calender. That is, the sheets may be heated and brought into intimate bonding contact between a pair of calender rollers. Accordingly, the method further includes the step of cutting or slitting said sheet layers into elongate strips after the thermal bonding step. The step of applying the coating of adhesive may be performed either before or after the step of cutting the sheet layers into strips.

5 For assistance in arriving at an understanding of the invention, specific examples thereof are hereafter described way of illustration only. These examples may be read with reference to the preceding description but are in no way intended to limit the generality of that description.

0 In one example of the invention a sheet of polyethylene film (thickness in the range of 20 to 40 μm) is superposed with a sheet of fabric. The sheet of fabric is a "warp knitted-weft inserted" fabric manufactured from yarns comprising a blend of polyester and polyethylene. For example, the weft yarns may be a blend of polyester and polyethylene. The reinforcement layer therefore includes at least a proportion of the same thermoplastic material (i.e. polyethylene) as the thermoplastic layer.

5 The fabric and film sheets are brought into contact with one another between a pair of calender rollers, after and/or during heating of the sheets by radiant heating elements to such a temperature that the thermoplastic polyethylene component of the fabric and the film softens sufficiently to achieve heat bonding in the form of a fusion weld between the film and the

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fabric. The thermal bonding takes place over substantially the entire interface contact area between the fabric and film sheets.

5 After the thermal bonding of the fabric and film sheets, a coating of adhesive, such as a rubber gum pressure-sensitive adhesive, is then applied to the outer surface (i.e. the non-film facing surface) of the fabric. This application of the adhesive coating is preferably done by passing the now bonded
0 sheets through a pair of calender rollers as described in US patent 4 304 813. The bonded and coated sheet is then cut or slit into elongate strips which are individually wound onto reels or spools to form the final adhesive tape product. The layer of extruded material of the composite material used as
5 tape substrate provides good release properties as the tape is peeled off the reel or spool during use.

As has previously been made clear, the invention allows for significant variation in the composition and construction of
10 the reinforcement layer. The yarns making up the fabric may be a wide variety of combinations of synthetic, natural and artificial yarns. Furthermore, the yarns may be whole or partly mono- or multi-filament yarns, spun yarns (using rotor, ring, friction or any other known spinning technique), or in tape
15 form including co-extended tape and filament yarns to which functional sizing is applied.

The composition blends of the yarns can essentially be in any percentages of yarn contribution provided that the
20 reinforcement layer and the layer of extruded material of the tape of the invention are still capable of bonding in the required manner.

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Claims

- 5 1. A by hand tearable composite material, in particular a
substrate for an adhesive tape, comprising
- a reinforcement layer in the form of a weft inserted knitted
fabric, and
- at least one extruded layer of thermoplastic material on one
0 surface of the reinforcement layer.
2. A by hand tearable composite material, in particular a
substrate for an adhesive tape, comprising
- a reinforcement layer in the form of a laid fabric consisting
5 of a warp and a weft, and
- at least one extruded layer of thermoplastic material on one
surface of the reinforcement layer.
3. A composite material according to claim 1 or 2,
0 further comprising at least one extruded layer of material on
the other surface of the reinforcement layer, in particular a
layer of thermoplastic material.
4. A composite material according to one of claims 1 to 3,
5 wherein the at least one extruded layer of thermoplastic
material on one surface of the reinforcement layer is
thermoplastic rubber.
5. A composite material according to claim 4,
0 wherein the at least one extruded layer of thermoplastic
material on the other surface of the reinforcement layer is
thermoplastic rubber.
6. A composite material according to claim 4,
5 wherein the at least one extruded layer of material on the
other surface of the reinforcement layer is thermoset rubber.

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7. A composite material according to claim 4 or 5,
wherein the thermoplastic rubber contains a polyolefine.

8. A composite material according to claim 7,
5 wherein the polyolefine is polypropylene.

9. A composite material according to claim 7,
wherein the polyolefine is polyethylene.

0 10. A composite material according to one of the preceding
claims,
wherein the bond locations between the reinforcement layer and
the at least one extruded layer of thermoplastic material on
one and/or the other surface of the reinforcement layer are
5 substantially evenly distributed over the interface between the
reinforcement layer and the extruded material.

11. A composite material according to claim 10,
wherein the extruded material covers substantially the entire
0 surface area of the reinforcement layer.

12. A composite material according to one of the preceding
claims, wherein the pitch between weft ends is at least 2 mm.

5 13. A composite material according to one of the preceding
claims, wherein the pitch between warp ends is less than
2.5 mm, in particular less than 1.4 mm.

14. A composite material according to one of the preceding
0 claims, wherein an adhesive is provided at one of its outer
surfaces.

15. A composite material as claimed in any one of the
preceding claims,
5 wherein the reinforcement layer is manufactured from a yarn
that includes at least some thermoplastic synthetic, preferably

selected from the group comprising polyester, polyethylene, polypropylene and polyamide.

5 16. A composite material as claimed in any one of the preceding claims,
wherein the adhesive is provided at a surface of said reinforcement layer and wherein the adhesive provides a further bond between the layer of fabric and the layer of extruded material.

0 17. A method of manufacturing an adhesive composite material comprising the steps of:
- extruding a layer of thermoplastic material to at least a portion of a surface area of a reinforcement layer of weft
5 inserted knitted fabric or a laid fabric consisting of a warp and a weft, and
- applying an adhesive to an outer surface of the composite material.

0 18. A method as claimed in claim 17,
wherein the bonding between the layer of thermoplastic material and the reinforcement layer occurs as the extruded material cools down or sets.

5 19. A method as claimed in claim 17 or claim 18,
wherein the thermoplastic material is applied over at least one surface of the reinforcement layer.

0 20. A method as claimed in claim 19,
wherein the thermoplastic material is applied over substantially the entire surface area of the reinforcement layer.

5 21. A method as claimed in any one of claims 17 to 20,
wherein the step of forming the composite material includes extruding a further layer of thermoplastic material to the other surface of the reinforcement layer.

22. A method as claimed in any one of claims 17 to 21,
wherein the layer(s) of thermoplastic material and the
reinforcement layer are substantially coextensive and wherein
the composite material is in the form of a sheet, the method
5 further comprising the step of:
- cutting or slitting said sheet of composite material into
elongate strips.

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- (71) Applicant (for all designated States except US): MIL-
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(54) Title: BY HAND TEARABLE COMPOSITE MATERIAL

(57) Abstract: The present invention relates to a by hand tearable composite material, in particular for use as a substrate for an adhesive tape such as, for example, a pressure-sensitive adhesive tape. According to one main embodiment, the composite material comprises a reinforcement layer in the form of a weft inserted knitted fabric, and at least one extruded layer of thermoplastic material on one surface of the reinforcement layer. According to another main embodiment, the composite material comprises a reinforcement layer in the form of a laid fabric consisting of a warp and a weft, and at least one extruded layer of thermoplastic material on one surface of the reinforcement layer. Production costs are thus significantly lowered without sacrificing other properties of the composite material.

INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER

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B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B32B C09J D04H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
E	WO 01 32395 A (MILLIKEN & CO ;WEIR MATTHEW G (US); MOORE MORRIS D III (US)) 10 May 2001 (2001-05-10) claims 1,2,9,10 page 2, line 1 - line 6 figure 2	1,3-5,7, 9-11, 14-21
X	DATABASE WPI Section Ch, Week 198814 Derwent Publications Ltd., London, GB; Class A81, AN 1988-096442 XP002174397 & JP 63 048379 A (MARUBENI KK), 1 March 1988 (1988-03-01) abstract	1,10,11, 14-20

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

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INTERNATIONAL SEARCH REPORT

Int. l. Application No

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 304 813 A (ELMORE JR ROLAND G) 8 December 1981 (1981-12-08) cited in the application claims 1-3 ---	1,4,5,7, 9-11, 14-16
A	EP 0 848 048 A (JAPAN POLYCHEM CORP ;DIATEX KK (JP)) 17 June 1998 (1998-06-17) claim 1 page 3, line 35 - line 50 page 8, line 49 -page 9, line 26 ---	1,3-22
X	DATABASE WPI Section Ch, Week 200012 Derwent Publications Ltd., London, GB; Class A81, AN 2000-130646 XP002187385 & JP 2000 001654 A (NIPPON PETROCHEMICALS CO LTD), 7 January 2000 (2000-01-07) abstract ---	2-11,14, 17-21
X	EP 0 528 563 A (MILLIKEN RES CORP) 24 February 1993 (1993-02-24) claims 1,2 figure 2 column 1, line 31 -column 2, line 3 -----	2,4, 7-11, 14-20

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP 01/04921

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
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Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
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FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1,3-16 (in part),17-22 (in part)

A by hand tearable composite material suitable for being a substrate for an adhesive tape, comprising a) a reinforcement layer in the form of a weft inserted knitted fabric, and b) at least one extruded layer of thermoplastic material on one or both surfaces of the reinforcement layer (claims 1,3-16). Furthermore, a method of manufacturing this adhesive composite material comprising the steps of a) extruding a layer of thermoplastic material to the surface area of the weft inserted knitted fabric, and b) applying an adhesive to an outer surface of the composite material (claims 17-22).

2. Claims: 2,3-16 (in part),17-22 (in part)

A by hand tearable composite material suitable for being a substrate for an adhesive tape, comprising a) a reinforcement layer in the form of a laid fabric consisting of a warp and a weft, and b) at least one extruded layer of thermoplastic material on one or both surfaces of the reinforcement layer (claims 2,3-16). Furthermore, a method of manufacturing this adhesive composite material comprising the steps of a) extruding a layer of thermoplastic material to the surface area of said laid fabric consisting of a warp and a weft, and b) applying an adhesive to an outer surface of the composite material (claims 17-22).

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/EP 01/04921

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